ject-matter in eleven chapters, of which the titles are as follows: Historical—The Measurement of Light Quantities—The Energetics of Radiation—Economic and Energetic Relations of Actual Light Sources—The Absorption of Light—Statics and Kinetics of Photo-chemical Change—Dynamics of Photo-chemical Change—Special Photo-chemistry—Radiant Matter and Photo-chemical Change—The Genesis of Light in Chemical Change—Organic Photo-synthesis.

The first four chapters do not carry us much beyond photo-physics, but give a very satisfactory résumé of those divisions of optical physics which are of primary importance in photo-chemistry. Beginning with Chapter V., the subject-matter becomes increasingly chemical in character, and the book ends with an excellent account of the more recent investigations into the character of the chlorophyll reactions.

To the reviewer the author's method of treatment seems most commendable. Such principles as may be considered thoroughly established are treated with scientific conciseness and brevity, not in general, however, without the presentation of sufficient numerical data for illustration. In dealing with matters which are still in the formative stage, a condition true of so much of photo-chemistry, the author does not dogmatize, but usually leaves the reader with quite the impression that the state of knowledge concerning the subject warrants. This makes the book valuable not only for the knowledge which it imparts, but also for its stimulus to critical thinking.

The book is made up quite directly from the original literature of the subject and is amply provided with citations and references. The author's personality shows itself not only in the thoroughness with which the material has been digested and assimilated, and later organized for the purpose of clear presentation, but also in not infrequent elucidating discussions and in occasional flashes of imaginative explanation. The reviewer's impression is that we have here the work of one thoroughly imbued with his subject, and at the same time entirely competent to handle it. The book should prove valuable not only to those desiring admittance to the charming mysteries of photo-chemistry, but should also be welcome as an additional weapon in the armory of the initiated.

S. W. YOUNG

STANFORD UNIVERSITY

The Hydrogenation of Oils; Catalyzers and Catalysis and the Generation of Hydrogen. By CARLTON ELLIS. New York, D. Van Nostrand Co., 1914. Price $4.00 net.

The book considers very fully the methods of hydrogenation, the various catalyzers, both the base and rare metals, and the mechanism of hydrogen addition. Besides this, the subjects of the analytical constants of the oils and their uses both for culinary purposes and soap making are thoroughly dealt with. About one third of the book is devoted to the methods for the generation of hydrogen, which is of prime importance: these include water gas, decomposition of hydrocarbons, steam on heated metals, acids on metals, the electrolysis of water, and the safety devices for handling the gas.

A feature of the book is the very complete citation of references and patents from the three principal languages.

The volume satisfactorily fills a decided want and may be unreservedly recommended to all interested.

A. H. GILL

A Text-book of Medical Entomology. By WALTER SCOTT PATTON, M.B. (Edin.), I.M.S., King Institute of Preventive Medicine, Madras, and FRANCIS WILLIAM CRAGG, M.D. (Edin.), I.M.S., Central Research Institute, Kasauli, Punjab. Christian Literature Society for India, London, Madras and Calcutta. 1913. Pp. xxxiv + 768. 84 pls. £1–1–0.

The protozoologist, parasitologist or physician who has occasion to deal with the arthropodan carriers of diseases produced by bacteria, Protozoa, or nematodes, has long been hampered in his investigation by reason of

the relative inaccessibility of the pertinent entomological literature. It is widely scattered in expensive journals of restricted circulation, often out of print, and very generally not to be had under any circumstances by workers on the firing line of research in the tropics far from libraries. To investigate even the commonest insects such as the house fly, the flea, the louse and the bed bug, requires an extensive and expensive library and when this is in hand the entomological novice is all too often nonplussed by the exasperating hiatuses in the information available and still more by the perplexing confusion in technical anatomical nomenclature as for example in the case of the wing veins of insects, and the parts of the thorax of the house fly. Text-books of entomology contain so little of the data essential to the workers in the fields of preventive and comparative medicine that they are practically useless as aids to the inquiring specialist.

This need (which has grown so rapidly in recent years) of an adequate text-book in this field bids fair to be very adequately met by Drs. Patton and Cragg's "Medical Entomology." The book is itself a product of this need of this frontier of science, for it has been produced by two experienced workers in the Indian Medical Service, and has been adequately illustrated and well printed in India.

The reader might perhaps infer from this that the book was a provincial one adapted to the locality of its origin. The insects with which it deals are most of them cosmopolitan, often to genera, and in many important instances, as in the fly, flea, louse and some mosquitoes, even to species. But far more important than the objective cosmopolitanism of the work is the broad and comprehensive outlook of the authors and their very sincere and painstaking effort manifest throughout the work, to make the book widely useful, soundly accurate, fairly complete, and wisely proportioned. The result is a treatise which will be indispensable to every worker in medical entomology in tropical or temperate lands.

It treats *in extenso* of insect morphology, drawing its material from those genera and species of medical importance with especial emphasis upon the Diptera. The classification is likewise carefully worked out with detailed treatment where significant, as for example in the case of those most concerned or under suspicion as carriers, such as the Psychodidæ, *Tabanus, Anopheles, Stegomyia,* Œstrid larvæ, *Musca* and *Glossina.* The life-history, breeding habits, seasonal prevalence, relation to environmental factors and the methods of collecting, rearing and feeding are carefully noted and the pitfalls which await the inexperienced worker are very frequently pointed out. One chapter is devoted to the fleas, one to the Rhynchota or bugs, and another which will be especially welcomed, to the Anoplura or lice. In every case the treatment is not restricted to known carriers, but others which are equally wont to fall into the hands of inquiring specialists are included. The known relations to disease are cited as in the many species of *Anopheles,* and the types of parasites known to occur in the insect, their location in the body, and in the life history, and the modes of infection, in fact the full medical bionomics of host and parasite are all briefly summarized.

The Acari and Pentastomida receive a full discussion, especially the first-named group, and there is a brief and rather inadequate section (the last) devoted to *Cyclops* in relation to the guineaworm. A closing chapter deals with those special forms of technique in the preparation of Arthropodan tissues and organs for microscopical examination which are supplementary to the usual lines of instruction given in medical education.

Brief bibliographies of the most important papers, synoptic keys of large groups such as *Anopheles,* by locality, for example of the Philippine Islands, simple but clear and adequate and fairly abundant illustrations, a full index, and a well organized and clearly written text all combine to render very useful an excellent scientific treatise. The defects due to inadequate editing in matters of correlation of references and in elimination of some obscurities of statement, to incomplete or inconveniently located explanations of figures,

and to some important omissions in bibliographies may well be corrected in a later edition.

CHARLES ATWOOD KOFOID
UNIVERSITY OF CALIFORNIA

SPECIAL ARTICLES

THE SIMPLEST CONSTITUENTS REQUIRED FOR GROWTH AND THE COMPLETION OF THE LIFE CYCLE IN AN INSECT (DROSOPHILA)

THE green plants are able to build up all the complicated proteins, polysaccharides and fats of their tissues from nitrates, phosphates and sulphates, on the one hand, and from CO_2, on the other. Those microorganisms which can not form sugar or starch from CO_2 must be offered a more complicated compound than CO_2 for the synthesis of their carbohydrates. They may be able, however, to form all their proteins from an ammonium salt or a single amino-acid. This astonishing synthetic power is in sharp contrast to the behavior of mammals which, according to Osborne and Mendel, can not grow unless one or more proteins are offered to them, for the reason that they lack the power of manufacturing the majority of amino-acids required for the building up of the proteins of their body.

Recent experimenters have pointed out that in addition to the chemically well-defined constituents of food, other more or less mysterious constituents, which only the living body can produce, are required for the growth of mammals. Thus Hopkins, and Osborne and Mendel have found that certain unknown constituents of milk or butter have a specific effect upon the growth of rats, and Allen has found that even a Diatom (*Thalassiosira*) grows incomparably better if one to four per cent. natural sea water is added to the culture medium.

It seemed of interest to find out which substances are required for the growth and the completion of the life cycle of such highly specialized animals as insects. The banana fly (*Drosophila*), on account of the ease with which it can be raised, served as an object for our investigations.

We wish to report only on one group of the experiments we have made, namely, those referring to the source of nitrogenous compounds required for the growth and the complete life cycle of these insects. Our culture medium consisted of a solution of the purest cane sugar or grape sugar obtainable, or of both, to which certain inorganic salts (Kahlbaum's purest) were added. To this medium was added a very small quantity (about 0.25 gram) of mechanically macerated Schleicher and Schüll filter paper (No. 589, "Blue Ribbon"), chiefly to keep the flies from drowning and to facilitate the raising of the larvæ. Dr. Levene was kind enough to have a nitrogen determination of the filter paper made, which showed that its nitrogen content is 0.008 per cent. In such a solution the flies laid their eggs. The larvæ hatched and increased slightly in size during the first days, but then their growth stopped, although they lived for a considerable time. If, however, a small quantity of one or two amino-acids, *e. g.*, alanine or glutaminic acid or others, or certain ammonium salts, *e. g.*, ammonium tartrate or succinate or a combination of one ammonium salt and one amino-acid, was added, the larvæ grew to full size and metamorphosed into pupæ and normal flies.

In these experiments everything used was sterilized, and in addition the culture media were heated for fifty minutes to about 100° C.; but since the flies were not sterile, the development of bacteria was not excluded. The flies were removed as soon as a sufficient number of eggs had been laid. In the majority of experiments no visible fungus formation occurred. When visible fungus growth took place the larvæ, as a rule, soon died or failed to develop.

If in these experiments the larvæ were actually able to manufacture all the complicated nitrogenous compounds of their body from one or two amino-acids or from one ammonium salt, without the aid of bacteria, it would indicate a power of synthesis equal to that of bacteria. In this connection it is of importance that the larvæ of the banana fly can be raised on their natural vegetable food without bacteria. Thus Guyénot has succeeded in raising aseptically forty successive generations of *Drosophila*, thereby proving that for